SOME EFFECTS OF CERTAIN PLANT GROWTH SUBSTANCES AND CARBONIC AND THIOCARBONIC ACID DERIVATIVES OF HYDRAZINE ON MAIZE

BY

HAROLD WESLEY GAUSMAN

B.S., University of Maine, 1949
M.S., University of Illinois, 1950

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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SOME EFFECTS OF CERTAIN PLANT GROWTH SUBSTANCES AND CARBONIC AND THIOCARBONIC ACID DERIVATIVES OF HYDRAZINE ON MAIZE

The primary purpose of this investigation was to delay the reproductive development of corn plants. It was assumed that applications of growth substances to corn plants might delay anthesis and silking to an extent which would be practical in crossing inbreds and single crosses which normally do not tassel and silk at the same time. Exploratory work revealed other problems concerning the effect of growth substances on the reproductive development of corn plants. Some of these were investigated under the supposition that the greatest change in reproductive development would occur if the growth substances were applied at the time of tassel differentiation.

Materials And Methods

Growth substances consisting of indoleacetic acid (IAA), napthaleneacetic acid (NAA), 2,3,5-triiodobenzoic acid (TIBA), and 2,4-dichlorophenoxyacetic acid (2,4-D) were applied to single cross corn hybrids, WF9 X 38-11 and WF9 X Hy2, at four different stages of development. These stages were: (a) before tassel initiation, (b) during tassel differentiation, (c) during microsporogenesis, and (d) when ear shoots were beginning to emerge.

A split-split plot design with 5 replications in 1950 and 6 replications in 1951 was used. Main plots consisted of growth substances, subplots times of application, and sub-subplots concentrations. The corn hybrids, WF9 X 38-11 and WF9 X Hy2, were in separate designs. Sub-subplots consisted of one hill in 1950 and 4 hills in 1951. Four concentrations of each of the various growth substances were used in an appropriate series for each time of application so that ortho-

gonal comparisons could be made.

Other investigations were conducted. Dilutions of carbonic and thiocarbonic acid derivatives of hydrazine ranging from 4000 p.p.m. to 15.6 p.p.m. were hypodermically injected into the growing points of corn plants during tassel differentiation. Maleic hydrazide was sprayed on various corn hybrids to study its effect on pollen sterility.

Characteristics studied included growing point development, plant heights, changes in growth habits, dates of anthesis and silking, number of silked ears, adventitious root development, tillering, and yield.

Experimental Results

Dates of anthesis and silking. Applications of 4000 p.p.m. and 2000 p.p.m. NAA made during tassel differentiation delayed both anthesis and silking of WF9 X 38-11 approximately 3 days. This delay was accomplished without a statistically significant reduction in yield of grain. Applications of 2000 p.p.m. TIBA, 4000 p.p.m. 2,4-D, and 4000 p.p.m. NAA, during microsporogenesis, advanced anthesis 3 days but did not influence silking. WF9 X Hy2 was relatively unaffected.

Growing point development. Gross and histological examinations of growing points 9 days after treatment with growth substances which had been applied before tassel initiation revealed the following when comparisons were made with untreated plants: (a) NAA and 2,4-D consistently delayed tassel development of WF9 X 38-11, (b) TIBA tended to promote tassel development, and (c) growing apices of WF9 X Hy2 were unaffected.

Effects on tillering. TIBA significantly increased tillering of WF9 X 38-11 when it was applied during microsporogenesis and tassel differentiation. Times of application of the growth substances most detrimental to tillering of WF9 X 38-11 were as follows: (a) NAA applied during tassel differentiation,

(b) TIBA and 2,4-D applied before tassel differentiation, and (c) IAA applied during microsporogenesis. Tillering of WF9 X Hy2 was unaffected.

Effects on number of silked ears. 2,4-D followed by TIBA and NAA increased the number of silked ear shoots of WF9 X 38-11 approximately 16% when applications were made before tassel differentiation. 2,4-D and TIBA applied before tassel differentiation increased the number of ear shoots on WF9 X Hy2 approximately 12%.

Maleic hydrazide and pollen sterility. Maleic hydrazide applied as a spray was not found to be practical as a method of causing pollen sterility.

Carbonic and thiocarbonic acid derivatives of hydrazine. No delay in anthesis and silking of practical significance occurred due to treatment of corn plants during tassel differentiation with carbonic and thiocarbonic acid derivatives of hydrazine.

Effects on grain yield. 2,4-D and IAA significantly reduced the grain yield of WF9 X 38-11 when applications were made before tassel differentiation. The yield of WF9 X Hy2 was significantly reduced by applications of 2,4-D and TIBA made during tassel differentiation.

Effects on plant height. Plant height was most significantly and permanently reduced by 2,4-D applied duirng tassel differentiation. A highly significant negative correlation was found between height of plants from ground level to tips of longest extended blades and height of plants between the first node and apex of the growing points.

Discussion And Summary

Evidence was presented that NAA may delay anthesis and silking to an extent which may be practical as a means of crossing inbreds and single crosses which do not tassel and silk at the same time.

A significant advance in anthesis over silking date of WF9 X 38-11 was found to result from applications of IAA, TIBA, and NAA made during microsporogenesis. It was postulated that macrosporogenesis occurred later than microsporogenesis, and the protandrous condition may have resulted from stimulation of staminate spikelets and/or microsporogenesis.

Evidence was presented that tillering was affected by growth substances applied after tiller initiation had occurred. Number of silked ear shoots was increased when applications were made before tassel or tiller initiation.

Comparable concentrations of the growth substances differed in their activity on the various characteristics studied. In general regressions of components of variance for concentrations of characteristics studied were linear.

The growth substances, with the exception of 2,4-D, temporarily inhibited plant height. Plants treated with high concentrations of 2,4-D were permanently reduced in height. Evidence was presented that the effect of growth substances on leaf growth was independent of the effect on growing point elongation.

It was emphasized that further investigations are needed concerning the effects of growth substances on the reproductive development of corn plants.

VITA

Harold Wesley Gausman was born on a farm near Alberta, Minnesota, December 21, 1921. After graduating from Alberta Consolidated High School in 1939, he entered the West Central School of Agriculture of the University of Minnesota for one semester. During 1940 he attended N.Y.A. School No. 1 at Shakopee, Minnesota. He was employed by the Douglas Aircraft Company, Santa Monica, California, January 1941 to August 1942. In August 1942, he enlisted in the Army of the United States and served as a pilot in the Air Corp. While in the Army he also attended Washington State College, Pullman, Washington, for one semester. After separation from the service, November 1945, he entered the University of Maine and in February, 1949, he received the degree of Bachelor of Science with high distinction. He entered the Graduate College of the University of Illinois in February, 1949, and received the degree of Master of Science from that institution in June, 1950. He has held a half-time graduate assistantship for three and one-half years.

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